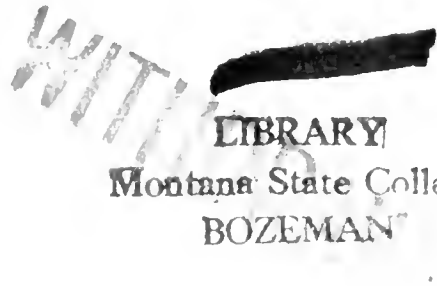

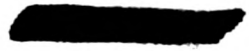

BIENNIAL REPORT

OF THE

INSPECTOR OF MINES

OF THE

State of Montana

For the Years

1907-8

WILLIAM WALSH, Inspector
WILLIAM OREM, Deputy Inspector

DECEMBER, 1, 1908

"INDEPENDENT PUBLISHING COMPANY, HELENA, MONTANA."

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Office of
Inspector of Mines.

Helena, Montana, December 1, 1908.

Sir:—I have the honor to herewith submit my biennial report for the years 1907-1908, complying with the law requiring reports from state officers, and making the Eighteenth Report of this department.

Respectfully,

WILLIAM WALSH,
State Inspector of Mines.

His Excellency, Edwin L. Norris,
Governor of Montana.

Introduction.

The Inspectors believe that the primary purpose of creating this office was and is to carefully examine the mines of the state, paying special attention to ventilation and timbering, for the protection of the men employed, for the express purpose of preventing accidents which occur in mines; with the object of becoming acquainted with the conditions causing the accidents, and also to suggest remedies which may add to the safety and health of the miners of the state, and reduce to a mimimum the accidents and fatalities.

The Inspectors take this opportunity of thanking the several managements for courtesies extended them to properly make the necessary inspections.

During my annual tour of inspection I found the majority of the mines operated in a fairly safe condition. The matter of ventilation has been taken into consideration and this has greatly improved conditions in the various mines throughout the state.

During the years 1907-8 Montana has maintained its position in the first rank of the leading precious metal producing states of the Nation. In the face of changing conditions with their resultant periods of industrial activity and depression, the production of gold during the past ten years has shown a fixed increase throughout the state considering the fact that copper, gold and silver bearing lodes of this state have not received much attention as compared with the interest exhibited by the miners and capatalists of other precious metal producing states, the record indeed is great, and if studied by the miners and mining investors can hardly fail to excite such an interest in the gold bearing rocks and gravels of this state as would lead to their active development, with the most promising assurance that the time, labor and capital expended upon the metalliferous leads and deposits offer opportunities for success second to none in the mining of any of the other metalliferous ores in the state.

The prospecting for, and the development of, the purely

silver bearing lodes has practically ceased, excepting in a few districts. an in these they are only able to operate because the ore carries high values. Most of the silver mines at present operating in the state are therefore merely battling for existence. Under prevailing conditions their owners are waiting for the turn in events which will bring with it such a price for the product of their mines as will permit the mining of the white metal at a reasonable profit. It must not be presumed from the foregoing that Montana is not a large silver producing state. On the contrary, silver is one of its chief metals, most of it, however, comes as a bi-product of copper, gold and lead. a comparison of the industry during the previous years shows a marked improvement.

More mines are in operation and a greater number of men are employed; better methods and results in the mining, smelting, milling and cyaniding are being used and obtained and the combination of these, and other processes which are being applied to the recovery of the values contained in ores of this character, tend to cheapen the cost of production and increase the profit of the operators.

The remarkable progress made in the development of copper, gold and silver mining during recent years marks an era of wonderful expansion and success in this department of productive industry. The great copper fields of this state are now furnishing the world with more than forty per cent of the copper.

The technical and economic phases of mining have been more thoroughly mastered than ever before. The wonderful mineral weatlth of the state is one of the greatest factors in its material prosperity, and no one can study the operations in the state's copper, silver and gold mines without being impressed with their great value, and importance to the nation. The copper and silver mines of Montana are an especially interesting study. They are decidedly the foremost copper properties of the world, having received the particular attention which they deserve. The descriptive sketches and the tabulated statements contained in this report have been prepared from the most reliable data, and much of the information is official, or of a semi-official character. The active and energetic operators of copper mines of this state have made splendid use of the gerat natural resources found at different mining centers. Constant

application of modern scientific methods has been effective in bringing the mining centers of the state up to the highest state of development. At the best known properties the modern up-to-date mining equipment now in operation at many of the copper, silver and gold mines are considered indispensable to the achievement of the highest success and they have been evolved from the experience and brains of men who devote their best efforts to the practical solution of almost every mining problem conceivable. Interests in copper mining has been increased in no small degree by the dissemination of reliable information, sent forth from honorable sources and prepared in attractive form, regarding the exploration and development of those copper properties which have become famous. As this knowledge becomes more generally diffused, capital and ingenuity will become further interested in the development of the copper mining industry.

In the last twenty years the annual copper production of the United States has increased from 90,646,080 pounds in 1882 to 917,805,682 pounds in 1906. The industry is established on a gigantic scale and it has become one of the principal sources of wealth to the state. The reader of the report will find abundant evidence to corroborate this statement. But who can safely predict the possibility of this new country. If the output of copper increases during the next twenty years at the same ratio as during the past, the year 2000 will show an output which would look truly appalling before this century closes. However, many of the large copper mines of the present day will probably have become exhausted and new sources of supply will have to be discovered to take their place. If we take a retrospect of the past, it will be interesting to note that fifty-eight years ago this country produced only 224,000 pounds of copper; fifty years ago 4,480,000 pounds; forty years ago 19,040,000 pounds; thirty years ago 34,720,000 pounds; twenty years ago 117,151,795 pounds; ten years ago 339,785,972 pounds; five years ago 546,262,987 pounds; and in the year 1906 the copper output of the United States was per official returns, 917,805,682 pounds. At an average of twenty cents per pound, this would make the production of copper for 1906 worth $183,561,136.40.

In 1907 the product of the mines of the state amounted to nearly $60,000,000 according to the estimate of the United States

Assay Office. From the best available data the production of the different metals is as follows: copper 225,975,000 pounds at an average of twenty cents $45,195,000; silver $8,000,000; gold $2,250,000; lead $2,500,00; total $57,945,000.

Montana leads all states in the production of copper and silver and if such is not the case, it is due to the heavy curtailment in Butte, and other districts throughout the state, rather than to any failure of the mines.

The mining and reduction of the metalliferous ores which are distributed over so great an area of this state will be the predominant industry for generations to come. Other industries suitable to our soil and climate will spring into existence, while farming and stock growing, with their kindred industries, will grow to enormous proportions, but the basis of the future prosperity and wealth of the state will nevertheless rest on its mineral lodes.

A good share of the prosperity which has attended the mining interests is due to discoveries of the metallurgist and mechanical engineers, and to those who have made a specialty of the recovery of gold from lower grade ores, through the medium of chemical solutions. These agencies have contributed much to Montana's future by reducing the cost of the recovery of the metals to a minimum. They have made it possible to mine and work at a profit millions of tons of ore, which, until recently, were as so much waste material.

In mining as in all other branches of industry, failures are met with.

The following touching on the manner of ore occurance in lode formation explains the cause of some It is quite common to find adjoining claims worked by their respective owners, located on the same vein, with conditions apparently identical, and the respective shaft or workings but a few hundred feet apart, are operating at a loss, the other at a profit. A reasonable percentage of the failures may be charged to the man, and not the mine. It matters not to the mine managers, (who is to-day directing operations on a large scale) whether there be one, or several, great ore bodies developed in the property which he is supervising. In prospecting and developing, searching for other pay ore chutes goes on the lean and barren portions of the lode; drifts are driven through both horizontally and to depth, ulti-

mately reaching a point in the vein where mineralization has concentrated, and another ore body has been added to those already in sight. By this system of constant development the mine management maintains several years ore reserves ahead, and each new ore body encountered adds to the life of the mine any where from one to several years, according to the size of the ore body uncovered. There is a very general misconception in the minds of foreign mining investors relative to the manner in which commercial ore occurs, and values are distributed. In the precious metal veins they frequently express dissapointment when on a visit of inspection to their properties they learn that all of the vein material found between walls will not pay working charges. It is absurd to look for any such conditions in the average mine. Certainly there are exceptions; for instance, a high grade streak of ore will permit, a medium grade product for the mill is had by putting lean stuff with it and making a medium grade product. The pay ores in the average fissures and contact veins do not occur either in uniform sizes, carrying equal values throughout; rather is it the rule to find each section of a vein differing widely in values, and frequently in size. Thus it is that the most productive mine, however extensively it may be developed, is always in a prospective stage of development.

A WORD ABOUT MINING.

Mining has been the foundation of the world's wealth from the beginning of time. The countries rich in minerals have always been the richest and strongest governments on earth. The mineral sections of any country have always ruled that country. Remember that the man who produces gold, silver, copper and lead is creating the raw material of money. Every stroke of his pick, every echo from his drill, adds to the wealth of every man's business. In the world, the miner of gold and silver is not a business pirate, and he is the only man who is not,—he never cuts prices, never creates strikes or tramples on the rights or privileges of a competitor. Mining is the only business on earth that increases the wealth of the world without robbing, or infringing on the rights of others. The miner is a man who finds the wealth, if you please, without juggling it out of some one else's pocket into his own. Mining has always been the quick road to great wealth. A country of great mines always becomes a country of great wealth, influence and power. What you say of nations, you can also say is true of the miners and prospectors of this country, provided, of course, it is carried on in a legitimate manner.

FUTURE OF MINING.

The demands of civilization for minerals and their products is likely to increase with time rather than decrease. Of course all the big deposits of the world have not yet been discovered, but a large portion of the world has been searched for the required minerals with more or less success, as the ores of useful methods are not produced by nature as fast as man depletes existing deposits, it is simply a matter of time before the human race will have exhausted the more easily accessible and richer deposits, and will have to fall back on those at present considered unprofitable under present conditions. In olden days slave labor made it possible for ore to be worked that otherwise must have been left for a later date. At the present time not only is the condition of the working miner better than of yore, but modern appliances and methods enable very low grade rock to be handled. There is no reason why future generations should not

improve on present methods, so that they can deal with ore of a grade now considered not worth while touching. When reporting on property it is not sufficient to look at it from the past, or even the present, but one must look ahead to a certain extent. Some properties can be condemned as out of the question at once, others warrant more careful investigation, and often the combined opinions of two or more specialists, for one man cannot be an expert on all subjects. He may be very good on technical points concerning the working of a mine, but may lack the intimate knowledge necessary to extract the metal from the ore by the most up-to-date method suitable for that particular ore, allowing for local conditions. Again, his business knowledge may be so slight that he would be unable to market the product to the best advantage, or advise as to the best method of financing the enterprise, for a mine may be good and the ore successfully treated, and yet the venture prove a failure from a financial point of view, owing to unsuitable capitalization, or some other foolish arrangement. Then there is the market price of metals to be considered, requiring a knowledge of the world's supply and demand. If a high price is likely to be sustained, then small deposits that would not otherwise be worked, may be brought forward with advantage, as has recently been the case with copper ventures. If a metal reached too high a price, then some substitute is sought for its common use. This tends to bring the price down again, or one metal may be affected by another, or by some special trade, such as tin, which is largely produced in silver currency countries, so that when silver is high it cannot purchase the same amount of labor as when low. Also, tin being chiefly used in the manufacture of tin plate, and tin plate being largely used in meat preserving works, the demand for that metal may be influenced by the canned meat industry. As an engineer has enough to do to keep up to date in his own particular line, he has to depend on the business man to a great extent for information of the wheels within wheels likely to effect the demand and price of a metal in which he is interested.

FREQUENCY OF INSPECTION OF MINES.

It has been rumored that a more frequent inspection of the various mines throughout the state should be made. This would require the state to appoint more deputy inspectors. I

infer from this that the inspector shall make such frequent visits to all mines in the state,—that he shall be responsible for all the workings being maintained in a safe condition at all times. A moment's consideration shows that this is utterly impossible, as nothing less than daily visits to each mine would be necessary. In the larger mines even the underground foreman, or superintendent, cannot visit all the workings each day, and he has to depend on his shift bosses, and on the miners themselves, to see that the workings are safely carried on. Furthermore, the inspector cannot take responsibility for work of which he has not the direction, and for men over whom he has not the control. The responsibility of carrying out the operations of mining in a safe condition must rest on the management, and its officers, and on the miners themselves. The duty of the Inspector is to visit the various mines in the state at least once a year, or oftener if necessary, to make sure that the work is being carried on properly by the management and men in charge, and especially to see that safe methods are being employed and that the proper machinery, tools and appliances are used. Special inquiry should be made into the circumstances of accident, in order to prevent similar mishaps from occurring again, and to enforce the provisions of the law. The inspectors cannot see how things are done in the mine every day, nor every month, and therefore must judge the work by the samples of it seen at each inspection. One important aspect of the question is that too much state inspection is injurious, as it has the effect of taking away the responsibility for the safe working of the mines from the mine management, which is entirely responsible for the work, instead of placing it upon the inspectors, who have no control over the property.

PLACER MINING IN THE STATE.

It is very difficult to obtain an accurate statement of the gross product of gold for the state for any particular year or period of years, owing to the many ways in which it is obtained in its native form and the different methods in which it is disposed of. The placer yield of the state since the discoveries of 1862 have run into the millions, much of which drifted into channels that financially found use for it without credit having been given to the placer mining. In other states placer mining has been carried on very extensively. In this state, during

1907 and 1908, especially in the vicinity of Virginia City, Madison County, several new discoveries have been made, and five electric dredges have been placed in operation. In Lewis and Clark County several gravel beds are in operation, employing the system of sluicing. The Cherry Creek Placer Mining Company, in Snowshoe District, in Flathead County, has begun operations after two seasons of prospecting and construction work. The company owns about one thousand acres of placer ground and has practically an unlimited quantity of gravel which runs very high to the yard in gold. The placer gravel, in the vicinity of Libby, has aroused the ambitions of mining investors, there were three hydraulic plants in operation at Libby during the year and there are three others in contemplation. There are many known rich deposits of placer gravel within the state that are dry and so situated that water cannot be taken to them without great expense, and these are lying idle awaiting the perfection of a practical machine that will extract both the fine and coarse gold with certain and ample profit to the owners.

The Allen Gold Mining Company is operating two placer mines in Deer Lodge County. One property is operated by means of a steam derrick, with hydraulic mining and sluicing and the other is worked by an Evans Hydraulic Elevator, using hydraulic pressure in the operation. This property has been worked very extensively during the year.

GENERAL REVIEW OF DISTRICTS.

Enormous values have practically originated at Butte, the greater portion of the production having been restricted to a small area not exceeding six miles square. The mines are in the granite mountain just above the city, and have made Butte the busiest and most prosperous place of equal population in the world. Its commercial importance, as the outgrowth of its mining activity, was such that twenty years ago the three greatest transcontinental railway systems of the United States were attracted to its gates, and sought to share in the great traffic here centered.

Butte was first settled in 1864, due to the discovery of placer gold in Missoula Gulch, now a part of the city. If the local history of Butte had been uneventful prior to the exhaustion of its gold bearing gravel, the discovery and working of the

silver bearing ledges on the hill afterwards brought little or no increased importance to the camp. The most important factor in the upbuilding of the city was the purchase of the Anaconda Claim by Marcus Daly, and the faith that he and others had in the future of the district.

There was nothing to indicate, and no imagination so wild as to guess, that at a comparatively slight depth the greatest deposits of copper ore yet known to the world would be uncovered. Most of the mines that at present furnish the principal wealth of the district are situated at the head of Dublin Gulch, and the famous Yankee Doodle Gulch, north and west of Meaderville. The mountain spur lying between this and Silver Bow valley is called Anaconda Hill, named after the famous Anaconda mine. The region is characterized by gently rounded topographical forms and a general barrenness of aspect. This latter is due largely to the cutting of timber for mine use following the first workings, and to the sulphur laden fumes from the smelters in the early day operations, since preventing a renewal of vegetation.

The syndicate system of veins have been opened continuously by underground workings for a distance of seven thousand five hundred feet on the strike. The direction of the strike is from North 65 degrees East to South 80 degrees East. The dip averages 65 degrees South. These lodes are notable because of their wide ore bearing zone, which is often from fifty feet to one hundred feet wide, both near the surface and in depth, although at intermediate points it may decrease to fifteen feet. This system of lodes have forks and spurs along it, so the veins are sometimes double and sometimes divided into parallel veins and cross-veins. The geological aspect of the Butte District may be divided into two basis of discussion; first, the rock formation or occurrences there appearing, and second, the fissure system. Another mode of division would be the geological aspect of the silver veins and the geological aspect of the copper veins. But as silver and copper veins occur in the same geological rock, and in the same fissure system, the more intelligent and preferable division of the rocks of Butte consists of granite, aplite, quartz, porphyry and rhyolite; the rhyolite is more recent than the other rocks, and than the ore deposits; its occurrence is a detriment, one might say, to the district;

it is largely confined to the northwest portion, and cuts in like a knee to the general symmetry of the ore deposits of the district. The granite is a part of the great mass extending from the vicinity: Helena on the North to the Elkhorn on the East, and the Highlands on the South. Granite is by far the predominant rock of the district. In general it should be said that the main fissure systems of the Butte camp is easterly and westerly. This is true of both the silver and the copper veins. So far, indeed, as observation can be made, there appears to be a common age for the fissure system which is prior to the mineralization; that is to say, that the silver veins and the copper veins occur in fissures of the same age. In fact, it is well known that many of the copper veins have been followed along in strike until they were practically silver veins, and vice versa. This great system of fissures extend as far East as the Basin and Corbin Districts, the formation of the country being identical. In addition to the main systems of East and West fissures, there are North 70 degrees West and North 70 degrees East in abundance, and northeast and northwest fissures become of great inmportance because of their influence upon the mineralization of the main East and West ore channels. This, indeed, has been the great lesson of the recent development work in the Corbin and Basin Districts. No fissure, indeed, has come to be despised in its relation with the other fissures of the mine, or of the district. Another important feature of the camps is the close interspacing of many fissures having the same direction. It is possible that the close interspacing of parallel fissures is responsible for the intense mineralization and the great width or size of many of the ore bodies in the districts.

The Judith Mountains, in Fergus County, are characteristic of those of the Little Rockies, in Chouteau County; the ores are mainly those of gold, a little argentiferous lead has been found, and the gold contains some silver alloyed with it, but silver is of minor importance in those districts. From an economic stand point the ores consist of country rock impregnated with, and replaced by, quartz and fluorite. As the most abundant minerals, they are all from the zone of leached and oxidized rocks. Like those of the localities mentioned they do not occur in veins, or in well defined chutes, as is so

commonely the case with gold ores. The occurrence of the richer bodies in the limestone near the porphyry contact is unique for gold ores; the characteristic ore of the district is more or less decomposed and crushed limestone, containing angular masses of brilliant purple fluorite and quartz intimately mixed. Another type, that of Gilt Edge, has no fluorite or other prominent gangue mineral of any kind, appearing to be merely an altered, crushed and brecciated clayey limestone. In the midst of so much alteration, and from the lack of any definite walls, it appears difficult to tell ore bearing material from that which is barren, except by assay checks, but the miners experienced in the gold working have an excellent idea of the commercial ore, which has nearly always a lively, firm, clinky feeling which practically means that those portions are the richest. In ores which have the most secondary silica, which would cover the character of the gold ores in these occurrences, sometimes it is rusty limonitic limestone, sometimes a dark brownish gray to a clear gray limestone.

The Neihart District, as described herein, embraces the mines in the vicinity of Barker, and belongs to the type of silver and lead deposits formed in limestone and occurring in chambers and pockets, and very seldom in fissure veins, which is also the case in the similar mining regions of Dry Wolf and Running Wolf Creeks.

The Yogo District, where the ore bearing solutions have followed lines of contact between ingenuous rocks and the sedimentary strata, in which they have been injected, as well as the mining districts directly tributary to Niehart, where the ores occur entirely within the area of crystalline shists and gneisess. As the Neihart and Barker Districts are the only proceeding districts at the present time, it will be considered more in detail than the others. The city of Neihart is the center of the district. It is situated on the Belt River, or Belt Creek, as it is called, which has cut out a narrow V shaped gorge, affording but scanty building space for the town. The mines include the silver bearing fissure veins, in the vicinity of Neihart itself, and the gold quartz veins of the new camp know as Johannesburg. The silver ores are mainly galena, but include also brittle silver, ruby silver, and more

sparingly other silver sulphides asosciated with these ores. There is considerable heavy spar and zincblend. These ores occur in narrow fissure veins cutting the gneisses and associated rocks of the archern area.

METHODS OF SECURING STOPES AGAINST WEIGHT.

This has frequently occurred in various mines in the state, where the veins stand very near perpendicular between the walls, they not having the same support of the foot wall as the vein which has much more of a dip, the foot wall in that case carrying the weight of the vein to some extent. Where the perpendicular veins have to be supported entirely by timbers, and require to be timbered closely in order to maintain the weight of the ore, which naturally keeps settling between the walls, the vertical vein should be timbered close and blocked well overhead to prevent its settling beyond control and becoming dangerous to operate, and should be closely filled with waste to prevent the timbers from swinging out of plumb, thereby losing their support against the hanging wall. The heighth to which stopes may be carried without filling should be determined primarily for the safety of the workmen. Accidents due to fall of ground are likely to occur when the stopes are carried so high that there are large overhanging masses of unsupported material. No hard and fast rule can be laid down on this point, and so long as the work is carried on in the manner that insures the safety of the miner. A safe rule to adopt is to timber all ground, the safety of which cannot be assured by frequent examinations and removal of loose material. Ground that requires timbers should be lagged closely overhead in all cases. The first indication of weakness in mine timbers is found, as a rule, at the joints of the different members of the set. In that of a stull by brooming off the ends, or in case irregular distribution of the comprehensive forces, a shearing or splitting. Of course, if the stull acts mainly as a support for material from above, then bending would be the first sign of weakness. This latter, however, is not the proper function of the stull. In such cases a set should be used, if it is possible. Of course, these signs are only to be witnessed in timber. Most of our readers who have had experience in timbering will recall the fact that many timbers may break without any previous warning. Some pines

are notorious for being brittle. Such timber will snap without the least warning. The general principles of timbering are few and simple, although subject to almose infinite modification. The rules adopted by an experienced timberman of our acquaintance are to give the maximum strength to the expansive part of the timber units, thus having the sets stronger than the lagging. Should excessive strain develop the lagging will show the effect first. The main sets can then be reinforced either by doubling up, or by reducing the distance between sets before any serious danger can result. In placing timbers, secure and block well at the corners, in order to prevent the weight from crushing the timbers until the pressure comes gradually on the sets. This will give the ground room to swell. The theory of this is that swelling is due mainly to oxidation. In the country the ground will frequently only swell when exposed to the air, if the ground is given a chance to expand, and thus swelling will be arrested, or partially so. In the interior of the rock mass, of course, where swelling is due to pressure developed by removing large ore bodies, the only way to take up the ground is to use heavy timbers, and more of them, and fill the stope as soon as possible so as to protect the hanging wall from swinging. We know of sill-drifts that have to be retimbered every two or three months, which can be avoided by driving latteral drifts in the country rock in the foot wall of the veins. The expense, of course, of retimbering is very great and in such cases the policy should be the latteral drift, which will stand for all time if properly timbered.

RECOMMENDATIONS.

In the course of the many years that I have spent in the quartz mines, during which many of the dangers of the avocation have only too often been brought to my notice in the most shocking and painful manner, I can truthfully say I have watched with interest every moment looking to the better protection of the miner, especially has this been true since the creation of the mine inspection department of this state. I have noticed how the well intended efforts of my predecessors in office have in the main, proved futile, and at this time I have little hope but that my successor will be obliged to chronicle the same as myself. This is not idle sentiment, but what I feel obliged to express by the importance and the necessity of those for whom

I feel in duty bound to plead. This department, in justice, cannot longer plead for a trial. The seventeen years of its existence has been ample time for its achievements to attest its ability or inability, to take care of the work entrusted to it. What are the amendments to the original law which its best efforts have accomplished? And on all sides what are the amendments and enactments only too evidently required. How few of the recommendations spread out in the sixteen annual reports on file have been seriously considered even in committee? To hope longer for redress in the face of such a record would be self deception. If our mining laws are to receive the proper revision, I, as a last resort, with all the earnestness at my command, would urge that a commission be appointed by the Governor to draft a set of mine regulations defining, in the language of another, as near as possible, the duty of the mine owner; the duty of the miner; the responsibility of the mine owner; the responsibility of the miner; what the mine owner shall and shall not do, and what the miner shall and shall not do. The cost of said commisison to the state can be made comparatively insignificant, for their deliberations can be limited to a short period, as this department could attend to the preliminaries, such as collecting reports of commissions, inspectors, and copies of regulations of other states and countries, as well as such other data as may be useful to said commission. In framing a set of regulations that will protect the miner, in so far as the hazardous nature of his avocation will permit, while imposing only such conditions on the mine owner as are necessary to that end, the work should be turned over to a commission consisting of five members, two to be mine owners, or their representatives, two to be practical miners, and they to select the fifth member. In the meantime, even should this commission be appointed, it will be one year before their recommendations can be acted upon.

The state must realize that the miner when underground has rights of person which it is obliged to protect, and while I do not doubt the wisdom of the broad liberality excercised by the legislators of our state towards private enterprise in its relation to servants, as in the building up of a new industry the less restraints imposed upon its initial efforts, the better, perhaps, for its success, I do most seriously doubt the wisdom of

continuing such policy, and in my judgment the mining companies' rights are protected under the present law to such an extent as that they can well afford to give due regard to the safeguarding of the lives and persons of their employees.

In my investigation at the mines I have everywhere been courteously received and assisted by those in charge, an assistance that has gone far towards enabling me to properly discharge my official duties with comfort and dispatch, and for this courtesy I beg to return an appropriate acknowledgment to the several managements.

The general laws relating to the safety of miners in this state, as they have been amended during the past, are reasonably good. The statute now empowers the inspector of mines to do and enforce any and all reasonable recommendations which he may deem necessary to protect the lives of the men employed in the mines, but under the laws governing this department, there is no specific statute governing the sanitary conditions in the mines. On the other hand there are constantly five or six thousand men, at least, underground on their respective shifts, which lasts for eight hours, and double that number every twenty four hours, the great majority of whom never see daylight from the moment they step on the cage until the expiration of their daily work. Absolutely no provision is made for the health of these men in a sanitary way. The territory in which this number of men are employed is extremely limited, and the demand upon the machinery during the respective shifts in those districts prohibits the employees from coming to the surface to attend to the demands of nature. This, then, compels the employees to use stopes, abandoned drifts, cross-cuts, and such other places as they may find convienient for their purpose.

I do not think that it requires any argument to convince any reasonable mind that the health of the employees cannot but suffer in consequence of these unsanitary conditions. I, therefore, strongly and earnestly recommend that a law be enacted which will provide for some sanitary regulation in mines and underground workings as will give the miner, in a small measure at least, the benefit of like sanitary laws obtaining and in force in our towns and cities.

VENTILATION AND SANITATION OF MINES.

Ventilation is the replacing of foul air contained in an enclosed space with fresh air from the atmosphere, and the mine inspector finds the keeping of air in circulation in the mines a very difficult proposition. The feature of his duties as to the health of those working underground depends on the air they breath; to a person accustomed to working out of doors the necessity of ventilation is not apparent, but to those working underground, where if the amount of natural ventilation is not sufficient, mechanical means should be applied to keep the air in motion. The case is very difficult, for regardless of what condition may exist, a practical and competent foreman will figure ahead to meet all emergencies, and as the conditions governing the ventilation of the mine are changing daily, it will require his constant and careful attention to keep the mine in good condition, so that it will be healthful for the miners as well as economical to the operators.

The necessity for good ventilation and sanitary conditions in mines is strongly insisted upon by all authorities from two points of view. From the humanitarian aspect of the effects on the health and longevity of the mining population, and from the merely economic one of the effect on the cost of production of minerals for which mining is conducted. The latter is greatly effected by the former as it is obvious that the working capacity of the men employed must depend upon their sustained physical condition and comfort with which their bodily exertion can be carried on, it is universally admitted that poor ventilation and sanitation are the cause of nearly all the ills that miners are subjected to. The improvements in health that follows improved ventilation have been strikingly illustrated in several of the mines in the Butte district. These mines have made upraises to surface for the purpose of discharging foul air and gasses, with the result that the health of the employees has been noticeably improved. The methods followed by the Inspector in examining the mines, the time being limited owing to the short time that can be devoted to each, as the number to be inspected is very large,—in all mines, the points at which men were working, were all visited, and such portions of them were examined so as to insure that the majority had been seen. The plans were looked over on surface, and notes taken

of any workings which seemed likely from their position, and relation to the main airways, to be poorly ventilated, especially raises and winzes in progress, and dead ends of long drives and crosscuts. These points were then especially examined, frequent inquiries were made from those working in the mines as to the state of ventilation, and we made it a point of visiting any place which we were told we ought to see. Special attention was given to the direction and volume of air currents in the workings; to the ventilating appliances in use for the production of air currents and to the doors and other means adopted for regulating and distributing the air. Personal sensation of discomfort, and observations of the condition of men at work in various places, together with noticing the way the candle flame was effected in size and brilliancy, had therefore to be our main guides as to the adequacy, or otherwise, of the ventilation, and the degree of humidity of the workings. The experience obtained in mines in various parts of the world from published sources of information, and the personal observations of some of our miners in the mines here, and elsewhere, have led us to conclude that the mines of Montana on the whole do not compare unfavorably as to ventilation with the generality of mines in other countries. One reason of this is that the lodes usually crop out at surface and the workings are connected with the surface by numerous openings. Most of our deeper mines, the old workings are filled with waste rock and decaying timber, and other stagnant refuse when in a decaying state has a tendency to make the air impure if the current is not sufficient to remove it to the surface, but while it cannot be said that ventilation in our mines is worse than in those of many other mining countries, we do not imply that it is by any means perfect, or that no improvement is necessary. On the contrary, we are strongly of the opinion that a great deal of improvement is both possible and very desirable. It is also to be borne in mind that the difficulties of ventilation increase as the mines become deeper and more expensive, and that we ought to avoid mistakes that have caused trouble with the ventilation elsewhere by paying greater attention to its requirements in the earlier stages of our mines' history, and exercising foresight as to the difficulties that must eventually present themselves. Unless we do so, there can be no expectation that the existing

favorable condition of ventilation can be maintained, and our mines will be as liable to cause a high mortality among the workers as those of any other country. Humanity and econmy demand that the ventilation should be taken in hand from the day of first opening a mine, and never afterwards lost sight of. It should be remembered that the quantity of explosives used in this state is very large, much above the average of most other mining states, and that there is a very serious vitiation of the air from their combustion, necessitating good currents of fresh air for their removal. There are places where miners have become sick and unconscious from bad air, but have recovered very quickly when brought out into a better atmosphere, cases which could only be due to inadequate ventilation. In several instances, no doubt, the inadequacy of ventilation was simply due to the fact that the men had returned too soon after firing, and had not allowed enough time for the removal of the noxious gasses, but in a good many others, ample time hade been given but through some slackness in the air currents the places had remained full of foul air; the stagnation of the air that causes such a state of affairs is liable to occur, at any moment if mines dependend entirely on natural ventilation. The necessity for mechanical ventilation after firing in close places has been strongly insisted upon. In mines ventilated solely by natural ventilation, it is evident that the variations of the conditions causing movement of air must be attended with corresponding variations in the velocity of the curernt, and consequently in the quality of air passing through, and the degree of purity which can be maintained.

Measurments of the quantities of air entering, leaving or passing any given point in a mine for tests of purity, therefore become of little use in determining the adequacy of the ventilation unless they are repeated at very frequnt intervals, and the results are averaged. The want of constancy in direction and volume of the currents of air in a mine, ventilated solely by natural ventilation, is therefore a grave difficulty in the way of practically establishing whether or not it is adequately ventilated. Great attention should accordingly be given to regulating air currents so long as to keep them as much as possible always moving in the same direction, and to avoid vitiated air being carried back into the workings.

MEANS SUGGESTED FOR IMPROVEMENT OF VENTILATION.

In this state the main problem is the bettering of the ventilation of the metalliferous mines, especially those which are large and deep. As regards to conditions we need add very little to what has been said in previous reports. The need being for the application of well known practices, rather than for any new or less expedient. The provisions of better designed and more powerful air currents, and more attention to keeping stopping-air-doors and brattices in good order. All this is necessary to make the ventilation as nearly perfect as possible, except for exploring purposes, ahead of the main work, the same precaution must be used as in long drives and crosscuts in metalliferous mines. In order to carry air to the working face, it is usually possible in the stoping portion to thoroughly ventilate such workings by use of bratticing. In other cases ventilation pipes may be used in some parts of the mines; also the ventilation would be improved by the greater attention to draining the traveling ways so as to prevent them from becoming exceedingly muddy and filthy as at present, as the tramped dirt especially on the horse roads is often very foul smelling. In the metalliferous mines the practicable means of improving the ventilation may be divided in to three; first, connections between workings to bring about circulation of the air; second, appliances for systematizing and regulating the air currents; and third, devices for mechanically ventilating the whole or any portion of the mines.

DEVICES FOR VENTILATION.

A great many different devices for mechanically assisting the ventilation of mines were mentioned by superintendents of various properties throughout the state with which they were familiar here and elsewhere, there can be no doubt that in order to insure a thorough and constant ventilation throughout a mine the use of a powerful fan is the most certain of obtaining the desired end when developing a mine is in progress, and that in very many cases where the natural ventilation presents difficulties, a mine can be thoroughly ventilated if the air courses are of sufficient size, but it often happens the outlet is too small to discharge the foul air and gases which accumulate in a mine. Instead of having the main shaft the up-cast,

it would be preferable to have it the down-cast, into the mine because it is much larger and will supply a greater current of air than the escape or the exit to surface which is generally too small to cause the proper suction in that respect. So long however, as a fair amount of natural ventilation can be obtained in metalliferous mines, in the course of opening them up, in ordinary way, it is hard to persuade owners to go to the expense of installing mechanical ventilation on a large scale, even though in many cases such ventilation would be so much superior that economy instead of expense would result. It is somewhat difficult to convince managers that this might be possible while the development of a mine is in progress, but the experience of quartz mines strongly supports the contention that mechanical may be even more economical than natural ventilation, should it enable the working force underground to do only one per cent more work in the same time, it would evidently be a very considerable item to deduct from the cost of development. That the state of ventilation does not effect the working efficiency of the men employed cannot be disputed, especially when the mines are hot. With better ventilation not only is it possible for men to work longer on account of more rapid clearing of the smoke from blasting, but the lowering of the temperature brought about, also enables them to exert themselves to better effect and to do more work, by being supplied with the necessary amount of air. Of all mining work the operation of raising from a lower level to a higher one is generally regarded as most likely to lead to injury to health among the workers. The opinion of the height to which raises might be carried should be limited by law. The relative danger of accidental injury in this sort of work as compared with other kinds of mining operations is a very serious one, but from the standpoint of ventilation we have given it considerable attention. The opinions expressed both by mine superintendents and men, as to the height which should not be exceeded were very various, from one hundred feet above the level to as much as two hundred feet being considered a fair limit. The most general opinion appeared to be that raises should not be carried up more than one hundred feet unless special circumstances made a greater height unavoidable. A great deal of difference of opinion was also expressed as to the best method of the construction of raises to ensure both ventilation and safe

working. The ordinary practice in this state, being as a matter of fact, to go up with staging constructed on stulls without any division of the raise. In my opinion the most feasible system of raising, that is, to construct a three compartment, the center one to be the chute and kept will filled with the broken rock, the advantage being that when there is a current passing through the level beneath, the air may be forced up one side an down the other, thus maintaining good ventilation, it also affords greater safety in working and there is less liability of the timbers being knocked out by blasting than with ordinary spreaders. Some managers consider this system of raising more expensive than the ordinary one. We are, however, of the opinion that the advantages of the three compartment box raise in center, and the ventilation and safety of working are very great and we recommend its use, in all raises intended to be over one hundred feet in height the method of raising diagonally on the plane of the lode instead of directly up it so as to have a raise with an inclination of not more than 65 degrees, instead of whatever may be the underlay of the lode, has also been brought to my notice, but while it would undoubtedly tend to greater safety from accidents it does not appear to have any advantages from the point of view of ventilation I would not however, recommend any specific limit to the height of raises as high ones are not infrequently unavoidable, and such a restriction would operate very injuriously to economical working. In such cases we think that the use of the box and mechanical ventilation and the enforcement of the previously recommended standards of allowing temperature and purity of air would remove the objections to raising in most of the mines in the state.

RECOMMENDATIONS.

Dealing With the Ventilation of Mines.

The methods by which the air in mines shall be regulated with regards to its adequacy in quantity, purity, temperature and humidity.

1st. The methods by which constancy in direction of air currents may or shall be produced in mines.

2nd. The conditions under which portions of mines may or shall be sealed off from the ventilation system thereof, and in what manner they shall be ventilated. The conditions under

which the use of mechanical appliances to assist ventilation shall be compulsory.

3rd. The storing and handling of explosives in mines.

4th. The time that must elapse before men return to places where shots have been fired in mines.

5th. The strength of caps to be used with different sorts of explosives and any other matters relating to the use of explosives in mines.

6th. Dealing with the connections of workings for ventilation purposes including the sinking of winzes in mines concurrently with shaft sinking.

7th. The connection of various workings in the mine by crosscuts, levels, winzes and raises.

8th. The height to which raises may be carried and the methods to be used in raising and the distances permissible between higher and lower levels and between air connections from one level to another.

Dealing With Sanitary Conditions of Mines.

9th. The construction and positions of sanitary conveniences on the surface and underground; the use of deodorants and disinfectants therewith; the system to be used underground; the time and methods of cleaning boxes and privies.

10th. The regulation of the places where men eat their food underground; the disposal of waste food and the cleaning of such places.

11th. The removal and destruction of waste refuse from underground stables, and refuse of all sorts liable to vitiate the air and the removal of stagnant water underground.

On the Ventilation of Mines.

12th. That the air in any part of a mine where men are working or passing shall be deemed to be pure air and in a fit state for working and pasing therein; that there is a perceptible current of air passing the place, tested sufficient to distinctly deflect the flame of a candle from the verticle, but such tests shall not be taken within ten feet from any face of a drive or crosscut, nor from the top of a raise or bottom of a shaft, or winze, not while rock drills are working so close to the testing point as to cause agitation of the air.

13th. The air shall be deemed inadequate and unfit for working or passing therein if any one of these requirements be not

complied with, and the tests necessary to obtain the information required about shall be made by the managers in every working place, at intervals of not more than two weeks and more frequently in such places as the Inspectors of mines shall require.

14th. In every mine there shall be constructed at the earliest possible moment one or more air ways independent of the main shaft or other principle entrance to the mine from the lowest level through to surface, of sufficient area to allow the passage of the amount of ventilation required by the mine, and such airway shall be maintained unobstructed.

15th. Where a lode is worked on the boundary of two adjoining mining properties, a pass shall be left along the boundary through the workings which touch it, and shall be maintained as an airway unobstructed. In filling stopes in a mine a rearing should be constructed so as to leave an airway between the filling and the unbroken portion of the reef.

16th. The air currents passing through every mine should be regulated so that the air shall pass through the workings from inlet to outlet, without local circulation that is to say, the same air shall not be allowed to return repeatedly through the same place.

17th. In every case when a shaft is being sunk, a winze should also be sunk so as to reach the level to be opened by the shaft in time to connect the level as it is driven on the vein, or by the crosscut, or drift, for ventilating that portion of the mine.

Sanitary Conditions.

18th. A sufficient number of privies for the use of the employees should be provided on every level in every mine having a depth of five hundred feet. In the privies the seats should be hinged so they can be lifted up and the privies should be removable so that the whole of the interior may be thoroughly cleaned, the top of the pans should not be more than one inch below the under surface of the seat. Guide bars should be provided for insuring proper emplacement of the pans, the pans should be made of impervious metal; the pans should be removable from the privies so they can be thoroughly cleaned and disinfected.

19th. Underground stables should be placed in a return airway and should be frequently cleaned, all manure and stable refuse should be removed from underground every day to surface and not stored in the mine.

GASES IN METALLIFEROUS MINES.

Gases in our metalliferous mines, generally spoken of as bad air, does not include the explosive gases common to coal mines. Neither does the term, as generally used, accurately define the condition of the air. It is a term applied to air obnoxious to the sense of smell due to the gases or smoke following the discharge of explosives and to air depleted to a greater or less extent, of oxygen. The latter is the condition most commonly referred to when the expression "bad air" is used. The term itself, however, conveys no idea of the actual condition of the air. Another common expression, when the air is low in oxygen, is to speak of it as being warm or hot. Although the hard rock miner has no means to accurately determine the percentage of oxygen present, there is an almost universal method of measuring or determining a condition of the air that is deemed safe or unsafe to work in. If an ordinary candle will not burn freely when held in a vrtical position, the air is said to be bad, but if the candle burns freely enough to avord light when placed upon its side, the air is usually light but not at all dangerous to work in. If one candle refuses to burn, when placed upon its side, combustion is often aided by the addition of another candle so adjusted as that the two flames join. This condition is likewise termed bad and considered near the danger point. If two or more candles refuse to burn, and light cannot be thus maintained, it is considered both bad and dangerous if exposure be long continued. When candles cannot be used, a torch burning kerosene is often resorted to and utilized for periods of exposure. This condition is also spoken of as bad air. Likewise, when a torch refuses to burn it is called bad air. But the latter condition is considered dangerous, and is generally described by the miner in such a forcible manner as to convey a fair idea of the actual condition of the air. To form an opinion therefore, of the bad air existing in any part of a metalliferous mine, one must learn the manner of testing it. So far as I know there have been no actual determinations made in the state of the percentage of oxygen in the air when one, two or more candles, or a kerosene torch, will not burn in a drift-heading or stope.

The view is generally advanced that an atmosphere that will not support combustion is unsafe and must not be ventured

into, and there is little doubt that this belief has prevented many acts of rescue. In cases of mine accidents, it has been demonstrated many times, however, that men can live for hours in air that will not support combustion of candles or even a kerosene torch. Some physicologists claim that air containing ten percent oxygen is respirable for a time without permanent injury. This percentage of oxygen is doubtless four or five percent below what will support the combustion of an ordinary candle, and it must also be below what is required for a kerosene torch. The miner's measure of bad air is, therefore, a safe one; provided, the atmosphere be only depleted of oxygen and poisonous gases do not exist in dangerous quantities. The percentage of oxygen may, however, be sufficient to support combustion and the atmosphere be absolutely unsafe to human life.

Accidents from the inhalation of poisonous gas is a subject of special interest to miners on account of their frequent exposure while working under ground. The best ventilated mines are not entirely free from this danger, and as a consequense miners are sometimes overcome by breathing gases collected or generated in stopes or recesses that can not be wholly purified where good ventilation has not been provided, as for instance, in shafts and tunnels projected by prospectors the danger is proportionately increased. The attempt to return too soon after blasting has occassioned loss of life. The introduction of compressed air as a motive power in larger mines is of signal service in this particular. After blasting, the air is turned on and the obnoxious gases driven out before the men resume their labors. The candle test for unsafe air is observed by miners generally. They know that an atmosphere too poor in oxygen to support the flame of a candle is unfit to breathe and precaution must be taken to avoid such localities when it is possible to do so.

NITROGLYCERINE COMPOUNDS.

The problem of thawing powder is the cause of many accidents, and is a hard one to meet with small operators and prospectors. The safest device for this purpose is the warm-water method, using a double chamber vessel and keeping the powder out of actual contact with the water and constant attention to cleanliness from glycerine, saturation of the vessel employed.

A fairly safe can made suitable for thawing from twenty to forty sticks of powder at a time, by building a solid oblong box of two or three inch plank, with a close fitting lid, and adjustable shelves. The box should be deep enough to accomodate an ordinary five gallon oil can in the center, and long enough to provide for two tiers of wooden shelves. The box should have a heavy and tight fitting lid, and when in use should be thoroughly banked about with dirt. A box constructed and covered in this way will preserve the powder at a proper temperature for a number of hours. The box in being used in surface work should be placed in an out of the way place and not near any buildings. If for convenience it must be placed at depth in workings, it should be deposited in a crosscut that is not at the time being used. The water used should never be heated with a candle, this being one of the most dangerous customs and prolific in its disasterous results. Any thawing device of whatever kind should be regularly and often cleaned, so as to prevent saturation of the wood with glycerine, as it renders wood, cloth, paper or earth dangerously sensative and liable to explosion by either heat or concussion. These preperations soften slowly at 60 degrees F., and should never be heated to a temperature beyond 100 degrees; and never, if avoidable, by dry direct heat, such as placing in direct contact with a hot rock, stove or metal surface of any kind, or before an open fire where the temperature of the powder is apt to raise suddenly.

Of course, the question of personal care always cuts a figure in this connection, for big mining operations are about as full of pitfalls as the skeleton frame of a skyscraper building, with the added advantage of the operation being always carried on by candle light. There are certain natural hazards to the business which cannot be eliminated, but a constant regard for the surrounding conditions on the part of the men should reduce the accident list to a minimum.

THE WASHOE SMELTER.

The Washoe plant at Anaconda, which treats the output of the Anaconda Company mines, also the Washoe Trenton, and the North Butte Company output has several departments for treating the material and they are being equipped with the most complete and modern devices yet discovered for such purposes.

The concentrator is a duplicate establishment. Each of the two structures being 255 x 335 feet, separated by a space of 135 feet between the buildings which is occupied by the power house. The eight divisions in the concentrator structure are so arranged as to enable each section to handle 5,000 tons of ore in twenty four hours and operate independently of each other if required. The crude ores are brought from the mines to the smelter, a distance of about twenty seveny miles and delivered into bins, from whence it goes to the crusher and then to the blast furnace. The steel power house contains two triple expansion engines of the Norburg type, each being of 3,600 horse power maximum and 2,000 horse power ordinary, there is also an auxiliary Fraser and Chalmers triple expansion engine of 1,400 horse power; there are two Westinghouse electrical generators and other machinery needed for the concentrating department. The entire plant has a capacity of 10,000 tons in twenty-four hours. The entire outfit of this great smelting plant is the product of careful experimenting and represents the best devices of able engineering and metallurgists. The smelting plant situated at Great Falls is also owned by the Amalgamated Company which treats the output of the Boston and Montana and the Butte and Boston mines, and has a capacity of 4,000 tons in twenty-four hours and is modern and up to date in every particular, and is reputed as treating ore cheaper than any other plant in the state owing to the magnificant water power obtained from the Missouri river.

NEW EFFICIENT SAFETY CATCH.

Hoisting operations in mines have long been recognized as having an inherent element of danger, and many efforts have been put forth to provide various means of safety. Our readers will doubtless recall the recent accidents which occurred in the state by defective cables and lives lost by defective safeties being used on cages in use. The general principle involved in these catches in the provision of some means of grapling wooden guides when the cage is decending at an abnormaly rapid rate. There has been patented in the state of Colorado a device to be used in connection with hoisting apparatus; it hs been devised and perfected; the inventors assert that this safety catch will absolutely obviate the occurrence of such

unfortunte accidents as have taken place in a number of Montana mines as well as other mining districts.

The first distinctive feature of this combination is that the safety catches are placed beneath the cage instead of at the top, as is universally the case. Another feature is that double means of safety are provided by this safety being used in connection with those now used on cages in the state. I will say in connection, should the support be removed or the hoisting apparatus get beyond the control of the engineer and permit the cage to fall rapidly through the shaft, these springs would instantanously force the draw head and its connecting rods downward and thus operate the safety devices beneath the cage and lessen the speed to a greater extent.

ACCIDENTS.

So much has been said from time to time on the subject of mine accidents, their cause and possible prevention, and with so little effect in so far as the procuring of legislative remedies, that it would seem that accidents which result in the death or maiming of a miner are such common occurrence, that they fail to arouse a spirit of inquiry as to their cause, or excite a disposition to provide remedies for their prevention.

While it is true that the percent of mine accidents in this state compare favorably with that of other states, it is still too high, and the fact that it is so is not due to any lack of effort on the part of this department in enforcing laws. In the course of official visits of inspection to the various mines in the state, every effort has been made to correct wrong methods, and dangerous practices are condemned and the adoption of meritorious safety appliances earnestly recommended. That the labor of this department in these directions has resulted in a general betterment of conditions in the mines cannot be disputed. There is still much to be done, however, in this line. The men employed in the large mines of the state are entitled to all the protection under the law, or that which they can receive from this department. It matters not that the inspector might find a condition that would indicate plainly the responsibility of the maagement, the coroner's jury makes its own verdict and usually insists on blaming Providence, by deciding that the accident was purely unavoidable, regardless of any evidence offered to the contrary. It must not be understood from the

comments made that all of the mine owners and mine managers in the state are heartless and indifferent to the safety and welfare of the employees, on the contrary there is, I am pleased here to make acknowledgement, a very considerable number of them who are as solicitous for the safety, health and general welfare of their employees as the most exacting requirements would demand. They feel a personal responsibility for the men under their charge and realize that their lives, in a large measure, are dependent on the precautionary measures adopted in their interest. When an accident occurs in a mine managed by any of these men, there is no attempt made to shift the responsibility on to some minor official, or to evade the most searching inquiry. Mine managers of this class operate the properties in their charge in accordance with a regulated and organized system, and when an accident occurs they are much more concerned in learining the cause and arriving at the true facts than the average coroner's jury. They want to ascertain if the positive orders issued by them are being obeyed or if there is any departure from the system adopted for carrying on the operations of the mine in its various divisions, and if so, to what extent practices representing individual views have crept in and how much are they responsible for the accident. And be it understood again that if the motives which actuate the class of mining men referred to in making such searching inquiries, philantrophy is the least. The prime motives are discipline, order and system, all ending in economy of management.

An analysis of the summary causes reveals the fact that the most prolific source of accidents is falls of rocks and caves of large masses of ground. The question of providing protection against falls of rock is a difficult one to meet, a great deal depends on the caution and judgment of the miner. It is impossible for the mine officials to visit every place in the mine at the same time, several hours may elapse before all the working places are seen, in the meantime the miners should see to it, and protect themselves, by trimming down all the loose and shattered rock, and if necessary to put in timbers, either temporary or permanent, so as to avoid danger in that respect, until he receives his orders from the man in charge. The cost of timbering is one of the largest items which enters into mining; it therfore follows that the aim of the manager is to adopt that

system which will entail the least expense, and provide safety. This means that more dependence must be placed on the ground to support itself, this tendency to shove down cost on material essential to safety, in order to make favorable comparisons on the production cost sheet, requires to be continually combated. Investigation of the mining accidents that have occurred during the past four years has proven to my satisfaction that of the many causes which contribute to accidents from falls of rock there are two which produces the greater majority of them, viz; Recklessness on the part of the miner, and negligence on that of the manager. I am pleased to report a very material decrease in the number of accidents caused by explosions the number of fatalities from this source in the past two years being ten only, one of this number was caused by a thawing device, the other nine being attributed to causes that appear unavoidable.

An important part of the mining laws of the state is in reference to the welfare of the employees, and in their interest the following recommendations were made to the various managments, and notices sent them during the years 1907 and1908.

NOTICES AND REQUESTS.

No.		
1.	In reference to timbering and timber	20
2.	In reference to places for storing powder	10
3.	In reference to quantity of explosives in magazine.	16
4.	As to storing inflammable materials in houses and buildings covering the mouths of tunnels	10
5.	In reference to apparatus for thawing powder	5
6.	As to employing cage tenders who should have exclusive charge of cages in shafts	8
7.	Regarding defective safety clutches on cages ...	9
8.	In reference to defective hoisting cables	6
9.	In regard to escapement shafts	11
10.	Regarding the number of men who may ride on skips and cages	8
11.	Forbidding riding on loaded cages, skips and buckets	9
12.	In reference to the use of state mining signals....	14
13.	As to the use of gates when lowering and hoisting men	12
14.	For providing better ventilation	25

15. As to providing tunnels with separate connections to the surface for escapes 10
16. As to leaving pillars of ground to protect shafts.. 12
17. Regarding the rate of speed in lowering and hoisting men 15
18. Repairing and putting in ladders 20
19. In reference to crossheads 9
20. To provide railings around shafts, winzes and manways 20
21. In reference to finger boards 15
22. Regarding bulkheads, damming of water in mines.. 8
23. In reference to filling of stopes to prevent caves.. 20

NUMBER AND CAUSES OF ACCIDENTS.

The following table shows the number of fatal accidents, and their several causes, occurring during the year ending November 30th, 1907.

Explosion of blasting powder	7
Fall of rock, or ground	13
Caught by cage in shaft	4
Falling down ore chute	6
Falling down manways	2
Suffocated by gas, or foul air	3
Killed in shafts	4
Defective engines	1
By ore train underground	1
Falling through floor in stope	1
Total fatal accidents for the year	42

The following is the number of non-fatal accidents, with their causes, which occurred during the year ending November 30th, 1907.

Fall of rock, or ground, or cave	11
Premature blasts and explosions	2
Falling in chutes	4
Caught by cages in shafts	2
Falling in shafts	1
By falling down manway	1
Total non-fatal accidents for the year	21

During the year ending November 30, 1907;

Mines inspected were	290
Men employed	15500
Fatal accidents	42
Percentage of fatal accidents to each thousand men employed	2.7
Percentage of non-fatal accidents to each thousand men employed	1.35

To the number of men employed, as stated above, five hundred may be conservatively added to include the scattered prospectors who are working their own claims, and to cover those employed in small properties, employing from two to five men, and leasers, making a grand total of sixteen thousand men which were employed before the reduction in forces took place in the state.

During the fiscal year ending November 30, 1908;

Mines inspected were	280
Men employed	14500
Fatal accidents	21
Percentage of fatal accidents per thousand men	1.32
Percentage of non-fatal accidents per thousand men	1.31

To the number of men employed as stated above, five hundred may be conservatively added as miners who are engaged in the development of numerous prospects that have not been visited by the inspector, bringing the total of men up to fifteen thousand.

The following table gives the number of fatal accidents with the cause for the year 1908:

Premature explosion of powder	3
Fall of rock, or cave of ground	6
Caught by cage in shaft	3
Falling down ore chutes	1
Suffocated by gasses	1
Falling down shafts	3
Struck by ore car in mine	1
Struck by falling timber	1
Falling down raise	2
Total fatal accidents during 1908	21

The following is the number of non-fatal accidents, with their causes, and where occurring, during the fiscal year 1908:

Fall of rock, or cave of ground	6
Falling in ore chute	1
Premature blast	4
Falling down shaft	1
Struck by falling timbers	1
Gas explosions	4
Total number of non-fatal accidents for 1908	17

MINES INSPECTED; MEN EMPLOYED; ACCIDENTS AND PERCENTAGES.

The following table gives the number of mines inspected, the number of men employed, and the fatal and non-fatal accidents in the metalliferous mines during the past sixteen years:

Years.	Mines Inspected.....	Men Employed.....	Fatal Accidents.....	Non-Fatal Accidents.....	Total Accidents.....	No. Fatal Accidents per 1,000 Men
1893	56	6,312	29	4	33	6.45
1894	78	7,082	27	19	46	3.81
1895	88	8,758	41	18	59	4.67
1896	78	7,727	64	21	85	8.28
1897	130	9,825	52	29	81	5.20
1898	136	11,096	48	29	77	4.32
1899	165	12,316	49	22	71	3.97
1900	163	13,996	47	35	82	3.26
1901	157	12,078	35	33	68	3.00
1902	169	13,784	47	45	92	3.41
1903	168	14,175	39	50	89	2.74
1904	176	14,480	41	55	96	2.83
1905	186	14,680	48	41	89	2.83
1906	190	15,000	52	43	96	3.21
1907	290	15,500	42	21	73	2.71
1908	280	14,500	21	17	38	1.32

To the men employed for 1908 may be added five hundred who are scattered over the state working their own prospects, and those employed as leasers, and employed in small mines, making the grand total for the year 14,500.

MINERAL OUTPUT OF THE UNITED STATES.

As nearly as can be estimated the mineral and metal production of the United States for 1907 was valued at $2,087.119.999. There are a number of mines, figures of the products of which were not completed, but we believe that our estimate will be found not far from the final returns.

An idea of magnitude and growth of the mineral industry in the United States may be had by perusing the accompanying table, which gives the values of the products for the years from 1883 to 1907, inclusive:

Years.	Total Production.	Annual Increase.	Annual Decrease.	Percent.
1883	$ 446,859,473	$.....	$ 5,041,686	1.1
1884	406,110,405	.....	40,749,068	9.1
1885	418,803,180	12,692,775	.....	3.1
1886	433,137,994	15,334,804	.....	3.7
1887	508,387,674	74,249,680	.....	17.1
1888	524,624,536	16,236,862	.....	3.2
1889	531,392,513	6,767,977	.....	1.3
1890	606,476,380	75,083,867	.....	14.1
1891	605,385,029	.....	1,091,361	.2
1892	622,543,381	17,158,352	.....	2.8
1893	543,693,967	.....	78,849,414	12.7
1894	549,374,763	5,680,800	.....	1.1
1895	640,771,528	91,396,769	.....	16.6
1896	640,544,221	.....	227,307	.1
1897	646,992,582	6,448,361	.....	1.0
1898	724,278,854	77,286,272	.....	11.9
1899	1,014,355,705	209,076,851	.....	40.1
1900	1,107,020,352	92,664,647	.....	9.1
1901	1,142,000,029	34,979,677	.....	3.1
1902	1,323,102,717	181,102,688	.....	15.9
1903	1,491,928,980	118,826,263	.....	12.8
1904	1,361,067,554	.....	130,861,426	8.8
1905	1,623,928,720	262,861,166	.....	19.3
1906	1,902,517,565	278,588,845	.....	17.1
1907	2,087,119,999	184,602,434	.....	9.7

It is worthy of remark that the mineral output of this country has been multiplied nearly five times during the last twenty-five years. Today America produces in values nearly four times more, in metals and minerals, than Great Britian. In 1907 the United States led the world in the production of coal, copper, lead, petroleum, natural gas, pig iron and many minor metals and minerals, and was second in gold output to the Transvall, and second in silver to Mexico.

Reviewing the mining industry of the world, we find that no other country has equaled the creditable record that has been maintained by the United States during the last quarter of a century.

MONTANA'S MINERAL OUTPUT.

Year.	Gold.....	Silver.....	Copper.....	Lead.....	Totals.....
1890	$3,300,000	$20,363,636	$16,665,437	$ 675,392	$40,995,465
1891	2,890,000	20,139,394	14,377,336	1,229,027	38,635,757
1892	2,891,386	22,432,323	19,105,464	990,035	45,419,208
1893	3,576,000	21,858,780	16,630,958	964,089	13,020,827
1894	3,651,410	16,575,458	17,233,718	730,551	38,191,137
1895	4,327,040	22,886,992	21,114,869	754,360	49,083,261
1896	4,380,671	20,324,877	25,356,541	670,010	50,732,099
1897	4,496,431	21,730,710	26,798,915	928,619	53,954,675
1898	5,247,913	19,159,482	26,102,616	809,056	51,310,067
1899	4,819,157	21,786,835	40,941,906	909,340	68,457,338
1900	4,736,225	18,334,443	39,827,135	701,156	63,746,727
1901	4,802,717	18,334,443	36,751,837	498,622	60,387,619
1902	4,400,095	17,622,285	24,606,038	332,749	46,961,167
1903	3,590,516	17,097,702	28,200,692	387,445	50,276,335
1904	5,097,786	18,887,227	36,410,301	195,525	60,590,848
1905	4,889,234	7,991,705	48,165,277	227,160	70,677,583
1906	4,469,014	8,027,027	56,105,288	254,390	68,855,764

PRODUCTION OF SILVER, COPPER, LEAD AND ZINC IN MONTANA BY COUNTIES IN 1906.

The source of production of metals in Montana in 1906, by counties, is shown below. In this table, and others which follow, Chouteau and Flathead Counties have been placed in one group, and Meagher, Ravalli and Sanders Counties in another group, to avoid disclosing the production of individual mines.

COUNTY.	GOLD PLACER		GOLD DEEP MINES		SILVER	
	Quantity Fine Ounces....	Value.....	Quantity Fine Ounces....	Value.....	Quantity Fine Ounces....	Value.....
Beaverhead	7.81	$162	99.55	$ 2,058	58,561	$ 39,236
Broadwater	201.22	4,160	7,380.26	152,563	47,853	32,061
Cascade and Chouteau	.....	.....	324.46	6,707	294,556	197,352
Flathead	332.05	6,657	13,219.11	273,263	14,989	10,043
Deer Lodge	152.63	3,155	3,934.77	81,339	4,270	2,861
Fergus	.....	.....	49,577.89	1,024,866	2,987	2,008
Granite	30.91	640	6,413.12	132,571	319,700	214,199
Jefferson	197.59	4,085	8,514.92	176,019	268,807	180,101
Lewis and Clark	529.92	10,594	25,327.03	523,556	102,689	68,802
Madison	18,916.71	381,041	13,142.24	271,674	117,476	78,708
Meagher, Ravalli and Sanders	81.39	1,745	63.59	1,315	935	626
Missoula	2,256.33	46,640	80.16	1,657	2,295	1,739
Park	70.94	1,466	319.26	6,600	122	82
Powell	2,123.68	43,900	2,402.06	49,655	29,434	19,721
Silver Bow	348.64	7,207	60,147.33	1,243,356	10,715,721	7,179,533
Total	25,242.81	$521,815	190,945.75	$3,947,199	11,980,705	$8,027,072

Production of Copper, Lead and Zinc by Counties.

COUNTY.	COPPER.		LEAD.		ZINC.		Total Value.....
	Quantity Pounds.....	Value.....	Quantity Pounds.....	Value.....	Quantity Pounds.....	Value.....	
Beaverhead	246,841	$47,640	243,022	$13,852	.....	$.....	$102,948
Broadwater	7,096	1,370	359,889	20,514	.....	.....	210,668
Cascade	360	70	569,046	32,436	.....	.....	236,565
Chouteau and Flathead	161	31	.....	.....	.....	.....	289,994
Deer Lodge	142,140	27,433	.....	.....	.....	.....	114,788
Fergus	3,318	641	100,914	5,752	.....	.....	1,033,267
Granite	63,626	12,280	294,517	16,786	.....	.....	376,476
Jefferson	255,428	49,298	811,616	46,262	.....	.....	455,765
Lewis and Clark	47,537	9,173	522,248	29,768	.....	.....	612,253
Madison	80,633	15,562	461,986	26,333	.....	.....	783,321
Meagher, Ravalli and Sanders	5,478	1,057	23,886	1,362	.....	.....	6,105
Missoula	57,436	11,085	.....	.....	.....	.....	61,121
Park	3,316	640	.....	.....	.....	.....	8,788
Powell	7,555	1,458	180,289	10,277	.....	.....	125,011
Silver Bow	289,780,050	55,927,550	895,566	51,048	6,579,000	401,319	64,810,083
Totals	290,709,975	$56,105,288	4,462,979	$254,390	6,579,000	$401,319	$69,257,083

Silver Bow county is the only producer of zinc ore in the state, although zinc ores are known to exist in several other counties. It is also the leading producer of gold, silver, copper and lead. During 1906 and 1907 the gold output of the county decreased slightly, but as the gold output in Fergus county shows a large decrease, Silver Bow retains its leading position in gold production. It produced during the year nearly ninety per cent of the state's silver output, and over ninety-nine and a half per cent of the copper production. It leads in the production of lead this year, displacing Flathead county in 1907. Jefferson county is a close second in lead production, followed by Cascade and Lewis and Clark. Jefferson county also holds second rank in copper output, with Beaverhead next. Granite county still holds second place in the production of silver, in spite of a large decrease. Cascade and Jefferson follow in rank. Fergus county retains second place as a gold producer, followed by Madison and Lewis and Clark. Madison county is the leading producer of placer gold.

The following table shows the number of mines, classified as to their chief product. There are one hundred mines which reported no production during 1907, and among the producing mines there are sixty-two placer mines, including four dredging placers and six drift placers. Out of a total of three hundred and eight deep mines, one hundred and thirty-seven are classified as gold mines, of which Madison county has a large share. There are seventy-eight silver mines, many of them in Jefferson county. There are seventy copper mines, chiefly located in Silver Bow county. There are twenty-five lead mines, of which ten are in Lewis ad Clark county.

Montana Mines Classified by Counties, and their Chief Product, in 1907.

COUNTY.	Hydraulic.....	Gold Drift.....	Placer Dredge..	Total	Gold.....	Deep Silver....	Mines Copper	Lead	Totaling	Producing Mines Reporting.....
Beaverhead	1	..	..	1	1	4	5	1	11	12
Broadwater	4	1	..	5	17	1	..	1	19	24
Cascade	..	..	..	..	1	13	..	..	14	14
Chouteau and Flathead	2	..	..	2	3	..	1	..	3	5
Deer Lodge	2	..	..	2	3	..	..	..	3	5
Fergus	..	..	..	..	5	..	..	1	6	6
Granite	2	..	..	2	8	14	1	1	24	26
Jefferson	1	1	1	3	17	26	3	4	50	53
Lewis and Clark	9	2	1	11	21	9	3	10	43	54
Madison	8	..	1	9	52	3	..	5	60	69
Meagher, Ravalli and Sanders	1	..	..	1	1	..	..	1	2	3
Missoula	9	1	..	10	..	..	3	..	3	13
Park	2	1	1	4	1	..	1	..	2	6
Powell	9	..	1	10	5	..	2	1	8	18
Silver Bow	2	..	..	2	3	8	49	..	60	62
Total	52	6	4	62	137	78	68	25	308	370

FATAL ACCIDENTS, THEIR NATURE AND WHERE OCCURRING, FOR THE YEAR 1907.

Date.	Name.	County.	Mine.	Causes.
Jan. 3	Geo. Grunvill	Lewis and Clark	Montezuma	Falling off ladder in shaft, falling down 50 feet.
Feb. 4	Lewis Beaver	Lewis and Clark	Jay Gould	Falling down ore chute in stope.
May 7	D. McEachern	Lewis and Clark	Cruse	By a premature blast in drift.
July 8	Oli Oar	Lewis and Clark	Spring Hill	By a premature blast on sill floor.
Feb. 18	E. Castallino	Jefferson	Elkhorn	By a premature blast on raise.
Mar. 24	Peter McNulty	Jefferson	Summit	By picking into missed shot in shaft.
June 27	W. B. Redding	Jefferson	Legal Tender	By the surface ground caving into stopes
Aug. 13	Peter Murphy	Fergus	Kendall	By falling through floor in stope.
Nov. 20	Nick Hanson	Chouteau	Alabama	By falling down ore chute.
Dec. 7	P. O'Connell	Silver Bow	Minnie Healey	By falling down manway.
Dec. 17	Will Cook	Silver Bow	Mountain View	By falling in ore chute.
Dec. 22	Pat Gibbons	Silver Bow	Diamond	By descending cage in shaft.
Dec. 23	Will Ahern	Silver Bow	Parrot	By rock falling down shaft.
Jan. 1	J. Driscovith	Silver Bow	Diamond	By falling in ore chute.
Jan. 10	J. Berryman	Silver Bow	Mountain View	By a fall of ground.
Jan. 27	J. Sullivan	Silver Bow	Speculator	By falling down manway.
Jan. 28	Mike Mullins	Silver Bow	Cora	Caught by cage in shaft.
Feb. 8	T. Harrington	Silver Bow	High Ore	Caught by ore train in mine.
Feb. 12	Fred Paine	Silver Bow	St. Lawrence	By a fall of ground.
Feb. 18	W. Guthrie	Silver Bow	Rarus	By a premature blast.
Mar. 3	D. W. Shope	Silver Bow	Pennsylvania	By a rock falling down manway.
Mar. 18	M. Swintner	Silver Bow	Pittsburg	By a premature blast.
Mar. 23	John O'Neil	Silver Bow	Bell	By a fall of ground.
April 6	Bob Bryant	Silver Bow	Leonard	Died from injuries received in shaft.
April 18	H. Southerland	Silver Bow	St. Lawrence	By falling of cage.
April 25	T. Presivich	Silver Bow	Rarus	By a fall of ground.
April 29	Patrick Rock	Silver Bow	Mountain Con	By a fall of ground.
May 2	D. D. Murphy	Silver Bow	St. Lawrence	By a fall of ground.
June 8	Al Thompson	Silver Bow	Pittsmont	Killed by a defective engine.
June 12	S. Micheal	Silver Bow	Anaconda	Injuries received from rock falling down shaft.
June 17	Mike Golden	Silver Bow	Minnie Healey	By falling down shaft.

FATAL ACCIDENTS, THEIR NATURE AND WHERE OCCURRING, FOR THE YEAR 1907—Continued.

Date.	Name.	County.	Mine.	Causes.
June 17	Mike Wicks	Silver Bow	Mountain Con	By being struck by ore train.
June 25	Dan Donlin	Silver Bow	Rarus	By falling in ore chute.
July 7	John Bath	Silver Bow	Lexington	By falling in ore chute.
Aug. 8	Fred Thomas	Silver Bow	Pennsylvania	By fall of ground in stope.
Aug. 16	Tim Crowley	Silver Bow	Pennsylvania	By fall of ground in stope.
Aug. 16	Will Sapeni	Silver Bow	Parrot	By a premature blast.
Aug. 25	John Leary	Silver Bow	Mountain Con	By falling down shaft.
Sept. 1	H. Shepherd	Silver Bow	Original	By fall of ground on sill floor.
Sept. 21	Frank Oliver	Silver Bow	Goldsmith	By fall of ground in stope.
Oct. 31	John Northan	Silver Bow	Mountain View	By fall of ground in stope.
Nov. 2	Ervin Best	Silver Bow	Mountain View	By fall of ground in stope.
Nov. 1	Chas. Dunn	Silver Bow	Speculator	By falling in ore chute.

NON-FATAL ACCIDENTS, THEIR NATURE AND WHERE OCCURRING, FOR THE YEAR 1907.

Date.	Name.	County.	Mine.	Causes.
June 18	Frank Killeen	Fergus	Barnes King	Leg broken by falling in shaft.
Sept. 3	Will Connor	Fergus	Barnes King	Leg broken by fall of ground in stope.
Oct. 2	John Smuck	Madison	Bismark	Loss of an eye by a premature blast.
Dec. 12	W. H. Rodgers	Silver Bow	Pennsylavnia	Leg broken by fall of ground in stope.
Dec. 14	Chas. Merrich	Silver Bow	East Gray Rock	Hurt by fall of rock.
Feb. 14	Henry Thomas	Silver Bow	Mountain Con	Injured by falling in chute.
April 3	J. Cassagranda	Silver Bow	Cora	Injured by falling in chute.
April 5	John Munson	Silver Bow	Lexington	Injured by cage striking chairs in shaft.
April 5	D. McLoud	Silver Bow	Lexington	Injured by cage striking chairs in shaft.
April 13	H. Sweeney	Silver Bow	Neversweat	Injured by falling in chute.
April 27	H. J. Shirk	Silver Bow	Anaconda	Injured by a fall of ground.
May 8	J. C. Shea	Silver Bow	Speculator	Injured by a fall of ground.
May 10	Jos. Dugal	Silver Bow	Minnie Healey	Leg broken from fall of ground.
May 10	Jas. Laurich	Silver Bow	Leonard	Leg broken by fall of ground.
May 15	James Connors	Silver Bow	St. Lawrence	Injured by sinking cage in shaft.
July 7	Pat J. Sullivan	Silver Bow	Bellmont	Leg broken from fall of ground.
July 9	John Fritz	Silver Bow	Neversweat	Injured by falling down ore chute.
July 30	Lem Bryant	Silver Bow	West Stuart	Leg broken by fall of rock.
Aug. 16	Jos. Simpson	Silver Bow	Parrot	Loss of an eye by a premature blast.
Sept. 20	Jack Nelies	Silver Bow	Anaconda	Leg broken by a fall of rock.
Oct. 29	John Conway	Silver Bow	St. Lawrence	Injured by falling down manway.
Nov. 5	Tom Murray	Silver Bow	Original	Leg broken by a fall of ground.

FATAL ACCIDENTS, THEIR NATURE, AND WHERE OCCURRING, FOR THE YEAR 1908.

Date.	Name.	County.	Mine.	Causes.
July 23	Morris Gubi	Jefferson	Elkhorn	By being struck by a mine car.
Dec. 25	Percy Bush	Silver Bow	Speculator	Caught by cage in shaft.
Jan. 6	Steve Hartnet	Silver Bow	East Stewart	By falling down shaft.
Jan. 26	Jack Morrison	Silver Bow	Lexington	By falling off cage in shaft.
Mar. 22	R. Howsworth	Silver Bow	Silver King	By a premature blast.
April 30	J. Sullivan	Silver Bow	High Ore	Struck by a piece of falling timber.
May 4	Dan McDonald	Silver Bow	Rarus	By descending cage in shaft.
June 13	Ed Lowney	Silver Bow	Gagnon	By fall of ground in stope.
May 20	Peter O'Neil	Silver Bow	Ellamalu	By falling down shaft.
May 22	Chas. Thomas	Silver Bow	Greanlief	By falling down shaft in lowering pump.
July 4	J. Halland	Silver Bow	Anaconda	By a fall of ground.
July 8	John Nyland	Silver Bow	West Colusa	By falling down raise.
July 20	John Bennette	Silver Bow	Anaconda	By a fall of ground.
Aug. 6	P. Callahan	Silver Bow	St. Lawrence	Suffocated by gas.
Aug. 4	Balango Binish	Silver Bow	Anaconda	By a fall of ground.
Sept. 16	J. McGovern	Silver Bow	West Stewart	By a premature blast.
Sept. 8	Guss Carlson	Silver Bow	Speculator	By falling down ore chute.
Sept. 17	Mike Lunney	Silver Bow	Diamond	By a premature blast.
Oct. 20	J. P. Byrns	Silver Bow	Anaconda	Neck broken by a fall of ground.
Nov. 9	James McDonald	Silver Bow	Neversweat	Skull crushed by falling down ore chute.

NON-FATAL ACCIDENTS, THEIR NATURE, AND WHERE OCCURRING, FOR THE YEAR 1908.

Date.	Name.	County.	Mine.	Causes.
Feb. 24	Tom Thompson	Powell	Lady Smith	Leg broken by a premature blast.
Feb. 24	William Linn	Powell	Lady Smith	Arm broken by a premature blast.
Mar. 16	Ed O'Niel	Missoula	Iron Mountain	By an explosion of gas.
Mar. 16	John Boyde	Missoula	Iron Mountain	Hands and face badly burned.
Mar. 16	Jos. Venter	Missoula	Iron Mountain	Hands and face badly burned.
Mar. 16	John Linin	Missoula	Iron Mountain	Hands and face badly burned.
Aug. 26	Will Swartz	Madison	Lehigh	Leg crushed by a fall of ground.
Feb. 8	Dan Donahue	Silver Bow	Leonard	Injured by falling down shaft.
Feb. 15	Walter Furlong	Silver Bow	West Colusa	By a premature blast.
Mar. 13	Dan Reardon	Silver Bow	Little Mina	Leg broken by a fall of ground.
Mar. 21	John Harris	Silver Bow	Pennsylvania	Leg broken by a fall of ground.
Mar. 23	John Fogerty	Silver Bow	Mountain Con	Crushed by a cave of ground. Has since died.
May 8	Lorn Keenan	Silver Bow	Gray Rock	By being struck by a piece of timber.
May 9	W. H. Curtis	Silver Bow	Anaconda	Leg broken by a cave of ground.
May 10	Robert Powell	Silver Bow	Leonard	Leg broken by a fall of ground.
Aug. 8	San Toy	Silver Bow	Buffalo	Leg broken by a fall of rock.
Sept. 26	D. Harrington	Silver Bow	Diamond	By a premature blast, arm badly crushed.

Report of the Deputy State Mine Inspector.

Butte, Montana, December 1, 1908.

William Walsh,
State Mine Inspector,
Helena, Montana.

Dear Sir:—

I herewith submit for your approval, my report of mines examined, their condition, together with a list of the fatal and non-fatal accidents, for the fiscal years ending, November 30, 1907-08.

Respectfully yours,
WILLIAM B. OREM, Deputy.

SILVER BOW COUNTY.

On account of the low price of the metals and the scarcity of money during the year 1908, the mining industry, not only of Montana but over the world has been almost at a standstill; nearly all development work being suspended and the output of the producing properties greatly curtailed. However, the situation is rapidly improving; the price of copper is advancing and the production of the mines of the Butte camp fast assuming normal proportions. With available money for new development work the coming year promises to be very prosperous.

The greatest boom to the mining industry is the cheap power now afforded by the development of the water power of the state for generating electric current; the plants of the Missouri River Power Company and the Helena Power Transmission Company on the Missouri River near Helena, the plants on the Madison and Big Hole Rivers, and greatest of all, the proposed installation at Great Falls, will furnish power for all mining and smelting operations and permit the development of properties where steam power would be prohibitive. This electric power is now in use at practically every property in the Butte camp for pumping and compressing air, and at a number of places

it is being used for hoisting. Its use is very beneficial to the matter of ventilation in the underground workings, doing away with the heat caused by the use of steam pumps.

The British Butte Mining Company at the present is undertaking something that has never been demonstrated in the state. They have a shaft 640 feet deep where they are pumping water into a series of dams. They are installing a dredge. The mine gives ample water for the operation, having had several experts from London that have sampled the ground thoroughly. They claim that it can be worked at a profit, if this is a success, it means everything for the claims in that locality, and especially in the state. This work is being done under the supervision of Col. DeHora, who has had years of experience in New Zealand, South Africa and Australia with dredges, it means an expenditure of several hundred thousand dollars. All mining men are deeply interested in this undertaking, hoping for good results.

I will endeavor to give below a brief description of the important improvements, developments, and conditions at the mines of the various companies. In all the large companies skips have been installed for hoisting ores, which will increase the production of these properties. The method of hoisting the skips is considered most economical, these skips have a capacity from six to eight tons and are attached either above or below the cages. Skip chutes are cut at the different stations in the shaft, having a storage capacity of any desired tonnage. Men, horses and electric motors are employed in tramming the ore, from the drifts and stopes of the skip chutes. The mouth of the skip chute opens into the shaft and the loading of the ore into the hoisting skips is done by the station tenders. Ores from the Boston Montana property are shipped to Great Falls for treatment. In the companies smelter there are 3500 tons treated daily. Ores from the other Amalgamated properties also from the North Butte, Red Metal, Lexington are shipped to the Washoe Smelter at Anaconda, where approximately ten thousand tons are treated daily. Ores from the Clark property are treated at the Butte Reduction Works, amounting to, about 1200 tons per day.

The satisfactory developments in a numebr of the Butte mines, the deepest workings now being 2800 feet, proves that the ore

bodies still continue in depth. The greatest problem to be considered in mining at this great depth is the matter of proper ventilation. Thissubject has received considerable consideration by the management of the large properties. From my observations in the different mines I am of the opinion that the correct way of getting good air into the mines is by means of air shafts, separate entirely from the hoisting shaft, and keeping this air connection as deep as the main working shaft. With two separate connections to the bottom level of a mine you secure a circulation that can be secured by no other means. In some instances connections made with other mine workings, as far as ventilation is concerned, is a detriment rather than a benefit as the air so received may have become impure from use in other workings. While it appears to be good air it is not and the effect is soon noticed by the men working in it. Connections with other properties are necessary for the safety of men. While most mines have separate escapement shafts it is not always possible to have the men so located that they are out of danger. If these connections are considered detrimental to either property the connection can be closed by a door to be used in case of necessity. Where the air shaft is carried down from surface, and working with connections made in different mines, it gives a circulation of pure air. When two shafts are sunk or raised to a common depth it is a consequence that one of them will be up-cast. I believe every mine should have its own air shaft and not depend upon connections with other mines. Air shafts should be sunk or raised in solid ground away from mine workings, and connections made with air shaft by cross-cut. By placing doors in the cross-cut it is possible to convey the air to any part of the mine.

Ventilation in the Amalgamated properties is greatly improved by a system of drainage tunnels through which the water from their mines is drained to central pumping stations, avoiding the necessity of pumping plants in the individual mines, reducing the temperature.

At the various mines where connections by means of air and development shafts have been made with the lowest levels the ventilation is all that could be expected. All companies realize that it is impossible to get the same amount of work when the air is poor, and therefore, it is to their advantage to secure the

best possible ventilation, the cost of making proper air connections is soon made up in labor. The waste from these connections being used for filling in stopes.

At the Leonard mine, since the new shaft has reached the 1500 level, the temperature has been reduced twenty degrees.

The Pennsylvania has raised an air shaft from 1200 to surface, and they are now raising from the 1600 to connect with 1200, which has made a great difference in the temperature.

The Mountain View has sunk and raised from the surface to the 1100 and connected to raise below. Also connect to High Ore 2100 this year.

At the Never Sweat mine a raise from 1800 level has been connected with the Moonlight shaft, giving the Moonlight additional depth and providing excellent air connection.

The Rarus has an air shaft completed to the 1600 level and are raising from the lower levels to connect. They have also made connections with the workings of the Tramway on the 1300 level, 1400, and 1500, which is beneficial in regards to air. These connections were made this year.

The Diamond mine connected with the Cora on the 2000, which will afford drainage and ventilation.

The Anaconda is connecting with the Belmont on the 1600 and 1800 levels, which will be a great benefit in regard to ventilation.

West Colusa has connected with the Alex Scott on the 1000 this year. They also have several raises from surface connected to the lower workings. This mine is considered one of the best ventilated mines in the district.

The Leonard mine has sunk two shafts for air, Gambetta No. 1, 300 feet; Gambetta No. 2, 900 feet, and have raises conveying the air to the 1100, also connected with the West Colusa, East Colusa and the Tramway.

The Badger State is sinking at the rate of 85 to 90 feet per month and has a depth of 700 feet, and intend sinking to the 2000, where connections will be made with the North Butte. It will be a benefit to both properties in regards to air.

The Diamond mine has commenced, sinking present depth is 2200 feet, intending to sink to the 2800 to connect with High Ore which will give good results, for an example, the St Lawrence mine, the cost of mining was very high since the air con-

nections have been improved they are mining at a lower cost than any mine in the camp. The same can be said about the Mountain Con and numerous others. Within the last four years there has been air development shafts sunk in this district at a cost of nearly a million dollars. Both proving the continuation of the ore bodies and bettering the conditions of ventilation.

It is safe to say, there is no place in the world they have less accidents for the number of men working than they have in this state. The year 1908, being the banner, only twenty-one fatal accidents and ten thousand men working in the Butte district, being 15 men less than the previous year, non-fatal accidents fourteen. With conditions improving each year, it speaks well for the camp and the managements.

EXPLANATION.

The statistical information and the physical condition of the different properties, usually published in the reports of mines, have been eliminated from our printed report by the order of Board of Examiners, owing to the condition of the printing fund.

This information was submitted to the Governor in our typewritten report to him.

Respectfully,

WILLIAM WALSH, Inspector.